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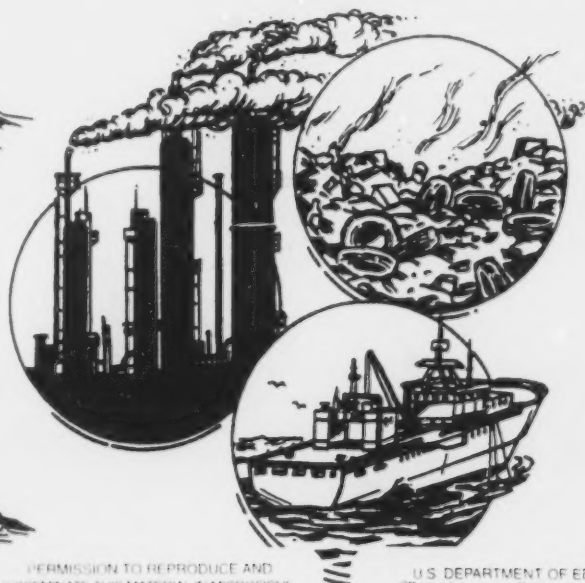
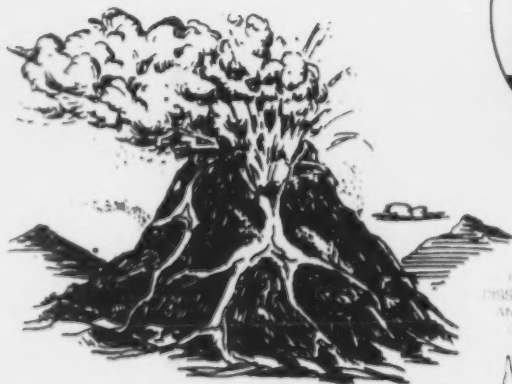
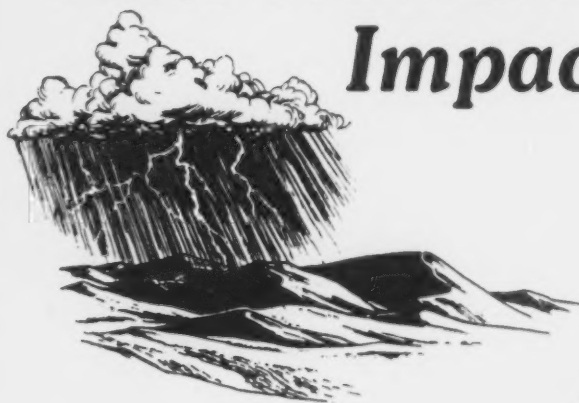
This book consists of two complete units on global change. The first unit is created for lower elementary students and the second one is for upper elementary grade levels. The units are designed for gifted students and encourage students to be responsible for their own education. Each unit is based on an interdisciplinary approach. Suggestions for adaptation of the units are also included. (YDS)

ED 446 982



GLOBAL CHANGE

How Humans and Nature Impact Our Planet



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Learning Packet

SE064239

Global Change

How Humans and Nature Impact Our Planet

by Mary Brown

Self-directed study units
for grades K-8

Process- and product-oriented
interdisciplinary learning through

- Evaluating
- Imagining
- Researching
- Reporting
- Thinking and reacting
- Mapping and charting
- Creating and appreciating
- Classifying and comparing
- Career exploration and goal clarification



REACHING THEIR HIGHEST POTENTIAL

Tucson, Arizona

Global Change
How Humans and Nature Impact Our Planet

Grades K-8

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Contents

The Premise	iv
Teacher's Section	
A Word to the Teacher	1
Rationale for Self-Directed Learning	2
From Passive Learner to Active Participant.....	4
The Format	5
Suggested Readings	6
Getting Started	7
Interest Development Center	8
To Prepare for Further Research	10
Suggestions for Adapting the Unit	11
Global Change	12
Glossary	20
Unit I: Kindergarten through Grade Three	22
Unit II: Grades Four through Eight	39
Answer Key.....	76
Bibliography.....	78

The Premise

Learning Is Natural

Children are active participants in their learning, not passive vessels to be filled.

They are always seeking and choosing what they will learn and what they will not learn.

Their interest, trust, and active involvement are crucial.

Children tend to become personally involved in projects that appeal to a variety of modalities—
reading, writing, reasoning, building,
imagining, and creating.

What a gift we give when we respect the child's
natural need to explore, to reflect,
to communicate, to dream, to celebrate!



REACHING THEIR HIGHEST POTENTIAL



A Word to the Teacher

Global Change

Many ancients believed that this planet is our “mother,” a living being, an integrated whole. As we progressed through history, our view of Earth changed to reflect societal changes. During the Industrial Age, for example, our image of Earth metamorphosed into one of a well-organized machine. As we learned more about the diversity of life on this planet, we began to observe her individual parts. Biomes, ecosystems, and communities were treated as if they were isolated entities. Only recently have we come full circle to a view that bears some similarity to the ancients’ view of Earth as an integrated whole. We regard Earth as a system; we think in terms of connectedness and interrelationships. We consider planet Earth as a series of networks, interdependent and self-regulating, that rely on feedback to adjust to changes.

Students studying from this learning packet will gain a sense of connectedness. Global change affects the entire planet. These issues are not isolated. And since they affect the entire planet, these issues also affect more than just the scientific nature of global change. Global change includes the history of our planet, the sociology of its peoples, the economy of its nations, and the diversity of life.

We hope that students, through their investigation of the complexity of global change, will appreciate the need for worldwide communication, the need for working cooperatively for a common goal, and the need for a broad understanding of the issues. We also hope that students who are investigating global change will see new solutions to some very complex problems. Our hope for the future is in their young minds.

Rationale for Self-Directed Learning

Our children's education must be more than the memorization of capitals of states, products of countries, and dates and places of past wars. Most teachers and parents would agree that it is important for our children to learn to think for themselves, to make wise choices, to work independently, to evaluate thoughtfully the results of their study, and to use their knowledge and skills creatively.

Obstacles to Independent Learning

In spite of the teacher's best efforts, many, if not most, classroom programs involve students in schedules and organizational plans that foster dependence rather than the independence we prefer. Students are told what to learn and how long it will take them to learn it. The teacher not only defines the resources but also decides whether the learning experience was a satisfactory and valuable one.

A Learning Atmosphere

Each time we, as educators, focus on what our objectives are, we need to take a fresh look at our classroom mode of operation and evaluate the effectiveness of the way we teach. Quite naturally, for most of us, our teaching style has had more to do with how we were taught than with what recent research has shown about the learning process. Even our good instincts have been overcome by the years of conditioning we have known in our own educational processes.

Like a breath of fresh air, recent findings from research on the brain support our intuitive knowledge. This research shows that our brains are receptive to learning only under certain conditions. Our job is to translate that information into a classroom atmosphere that provides

- challenge
- freedom within structure
- trust and warmth
- recognition of each student's learning process
- opportunities to experience success
- personal involvement in the curriculum

A natural transition generally occurs that transforms the former "teacher-lecturer" into a "fellow learner." As fellow learner, the teacher becomes a resource person, a facilitator, and a classroom manager. In this maturing atmosphere, students gradually come to see themselves as responsible for their own learning, and a foundation for self-direction is set.

At this point, an unexpected problem sometimes arises. We find students no more ready for their independent learning than we, as teachers, were ready to allow it. This common occurrence is mentioned repeatedly in the literature dealing with programming for the gifted, an area in which independent study and research are recommended as major curricular activities. See Suggested Readings.

From Passive Learner to Active Participant

(Bridging the Gap)

The Zephyr self-directed study unit was developed expressly to bridge that gap: to transport students from the position of passive recipients to that of active participants in their own pursuit of knowledge.

Within the defined structure of each unit, students are given opportunities to

- make choices
- learn at their own paces
- learn in a manner suited to their own learning styles
- expand their research skills
- use a variety of modalities
- plan their own time
- develop the skills of creative, critical, and evaluative thinking
- experience whole-brain learning

Because assuming responsibility for directing their own learning is often an unfamiliar situation for students, they will need your encouragement at the start. Generally within six to nine weeks most students will be well on their way from teacher-dependence to self-motivation. (Beginning the venture with only a few choices, then gradually arranging the setting so that there are more and more choices works best.) As students assume more responsibility, many teachers begin to consider the school library as just another part of the classroom. Both teachers and students can benefit from the enormous resources available in most school libraries.

Eventually, a few students will be ready for a true investigative research study of professional quality as suggested by Joseph Renzulli in *Enrichment Triad Model: A Guide for Developing Defensible Programs for the Gifted and Talented*.

The Format

These units were originally developed for gifted students, but we now recognize that every child is gifted in one or more of the multiple intelligences. The units emphasize the use of higher-level thinking skills and are appropriate for use in any classroom where the goal is to encourage students to become responsible for their own education.

Interdisciplinary in content, each unit envelops a broad view of the topic by integrating the "basics" into each activity.

Within this book are two complete units: one created for the lower elementary student and one for the upper elementary student. Suggestions for adapting or adjusting either of the levels to fit any individual classroom are included.



Suggested Readings

Self-Directed Study

- Armstrong, Thomas. *In Their Own Way: Discovering and Encouraging Your Child's Personal Learning Style*. Los Angeles: J. P. Tarcher, 1988.
- Brewer, Chris, and Don G. Campbell. *Rhythms of Learning: Creative Tools for Developing Lifelong Skills*. Tucson, Ariz.: Zephyr Press, 1991.
- Clark, Barbara. *Optimizing Learning*. Columbus, Ohio: Merrill Publishing Company, 1986.
- Gallagher, James. *Teaching the Gifted Child*. 3d ed. Boston: Allyn & Bacon, 1985.
- Gardner, Howard. *Frames of Mind: The Theory of Multiple Intelligences*. New York: Basic Books, 1983.
- Kline, Peter. *The Everyday Genius: Restoring Children's Natural Joy of Learning*. Arlington, Va.: Great Ocean, 1988.
- Maker, C. J. *Curriculum Development for the Gifted*. Rockville, Md.: Aspen Systems Corporation, 1982.
- Malehorn, Hal. *Open to Change: Options for Teaching Self-Directed Learners*. Palo Alto, Calif.: Scott Foresman and Company, 1978.
- Miller, Ron. *What Are Schools For? Holistic Education in American Culture*. Brandon, Vt.: Holistic Education Press, 1990.
- Purkey, William, and John Novak. *Inviting School Success: A Self-Concept Approach to Teaching and Learning*. 2d ed. Belmont, Calif.: Wadsworth Publishing Company, 1984.
- Renzulli, Joseph. *Enrichment Triad Model: A Guide for Developing Defensible Programs for the Gifted and Talented*. Mansfield, Conn.: Creative Learning Press, 1977.
- Stoddard, Lynn. *Redesigning Education: A Guide for Developing Human Greatness*. Tucson, Ariz.: Zephyr Press, 1991.
- Udall, Anne J., and Joan E. Daniels. *Creating the Thoughtful Classroom: Strategies to Promote Student Thinking*. Tucson, Ariz.: Zephyr Press, 1991.

Getting Started

1. Select a topic as an extension of a regular subject (particularly when your class seems to crave more), or select a topic to pursue that is of particular interest and may not be a part of the curriculum. To zero in on special interests, administer an interest survey to each student.
2. Copy the unit for each student. When using these units for the entire class, you may want to expand or delete activities for individual students.
3. Set up a center in the classroom that encourages exploration in the subject field. You'll want to include a variety of materials. Be creative—the purpose of the center is to excite the students, so begin with lots of hands-on materials. Allow for ample browsing time and encourage students to investigate and become absorbed.
4. Go over each activity in the unit with the students, discussing and answering any questions. You, as teacher, are the key to successful implementation. Because most children are already well versed in the "One Right Answer" game, they will need encouragement to branch out into many of the open-ended activities in the packets.
5. Set the stage. Plan conferences and provide resources as needed. Then, get out of the way and let your students learn.
6. Give as much time as each student needs to complete each activity in the unit. The entire packet might take from five to ten weeks or longer.
7. As each activity is completed and evaluated, initial the activity near each number. You will want to evaluate on the basis of the response that is appropriate for each individual student.
8. When a student shows extreme interest in the topic, the completion of this unit might be only the beginning. This student may be ready for further study and research and may need only resources, guidance, and freedom to pursue his/her well-planned project.

Interest Development Center

Global Change

Books, magazines, posters, filmstrips, videos, and charts on the following topics:

- environment
- weather (specifically weather patterns)
- volcanoes
- earthquakes
- climate
- agricultural practices around the world
- forestry
- acid rain
- pollution
- ice ages
- greenhouse effect
- ozone depletion
- economics of agriculture
- sustainable agriculture
- organic farming
- ecology
- history of ecology and conservation efforts
- conservation
- recycling
- waste disposal
- charts that show trends of resource use

Speakers

- traditional farmer
- organic farmer
- environmental engineer
- landscape architect
- agronomist
- plant ecologist
- range scientist

forester
conservationist
ecologist
oceanographer
meteorologist
environmental analyst
city planner
environmental adviser

Maps

the world
prevailing weather patterns
environmental atlas
polar regions and current average temperatures

Equipment

drawing implements
calculators
televisions
video machines
tape recorders
CD players

Items for Investigation and Experimentation

materials for measurement of environmental factors
HACH kit
materials to test for air impurities
weather station equipment
materials for greenhouse experiment
reference materials

Music

new age and environmental music, including ocean sounds,
sounds of the rain forest

To Prepare for Further Research

Students will need to decide:

- What will the study be? What will be investigated and produced?
- Where will the background information be found (e.g., speaker, interviews, books, film, microfiche, documents)?
- What, exactly, will be the form of the product: a model, a manuscript, or . . . ?
- Who might be interested in the product: professionals in the field, publishers, organizations, or . . . ?
- What is needed to begin: specific plans, resources, deadlines, or . . . ?

Suggestions for Adapting the Unit to Your Particular Learning Situation

- Require fewer or more research sources.
- Assign more of the activities to small groups instead of to individual students.
- Give fewer or more choices.
- Delete some activities altogether.
- Arrange the unit as a class project and have students choose different parts to complete.
- Add some activities of your own.

Global Change

I felt the now familiar tumbling motion. It was clear that we were traveling back. Over and over my body spun, tipping in space to go through an increasingly narrower tube. With my eyes closed tight, I could only imagine what it looked like. It would end with a soft thump; then we would be back in our classroom. Back in the correct century at Hampton Middle School.

Thump.

I opened my eyes.

"Ah!" I screamed.

"Ah!" He screamed back at me.

He was clutching my jacket. I stared at his mittened hand. He must have grabbed me at exactly the right second to be here now.

Panic set in; I was in big trouble. There's no hiding a Viking from 1450 in Hampton Middle School. I mean, some kids look strange, but no one looks quite this strange. The rest of the class began to panic, too.

Even Mrs. Lucas seemed upset. "Oh, dear," she sighed. "How did that happen?" she wondered aloud.

I stared at him. He was about my age. He wore animal fur from his scraggly red-haired head to the toe of his sealskin boot.

I watched him get curious. He stared at the room as if it were something from beyond the imagination. The rest of the class stared back. No one spoke a word; all eyes were on the Viking.

Except for the stranger, the classroom looked typical. I held the computer mouse; the rest of the top-of-the-line, high-tech, large screen machine was on its portable cart.

The Viking was gazing in wonder at his new surroundings. He looked at the computer, and his mouth dropped open. He looked at the ceiling, the desks, the books on the shelves with the same expression. Although he didn't try to communicate with us, his reactions were all the same. He was fascinated with everything his baby blues lit on. "Good," I thought. "We'll have time to think about what to do with him."

We were startled by the sound of someone coming toward our classroom. My heart sank. The heavy footsteps outside the door were unmistakable—our principal.

Before we get into him, let me tell you about Mrs. Lucas. She's one of the best teachers I've ever had. But she's different. I mean she has a way of really getting you involved with the subject. And I don't think she wants everyone to know about her "way." Some of it is just typical teacher stuff. She asks questions, makes you accountable and responsible, and insists you use the "proper terminology" during a unit. But her computer makes her more than just a great teacher. It has some sort of extra powers. I mean it really takes you places. In the last few months, it has taken us to an active tornado, to the basement of Czar Nicholas, and into a diatom. But today's situation was more than virtual

reality. I mean, I had brought back a Viking from the year 1450, something I didn't think our principal would understand in the slightest.

"We're just about to finish a student presentation on global change. Would you like to see it?" Mrs. Lucas asked, meeting the principal at the door.

"Perhaps tomorrow," he said. He handed her some forms and, noticing the Viking and me, said, "Yes, I would really like to see this presentation tomorrow." Then he left.

"You two may sit down," Mrs. Lucas said as she indicated a spot near the door. I pulled the Viking by his mittened hand and motioned for him to sit down. He plunged his fur-covered behind into the closest student desk.

"Class, tomorrow we'll finish our presentations. First we'll finish the presentation on the Little Ice Age," she said as she nodded gently in my direction. "Then we'll look at deforestation, habitat destruction, ozone depletion, and the greenhouse effect," she continued. "When the bell rings, you may go."

When the other students had gone, I said, "I'm sorry, Mrs. Lucas. He must have grabbed my jacket the instant the computer started to move us back to the classroom."

"Very likely," she agreed. With the door safely closed, she continued. "Now, we're just going to have to send him back."

As she thought about what we might do, I replayed that morning's field trip. As I was delivering my report on the Little Ice Age, I had clicked on Greenland on the world map, then carefully typed in "1450." I wanted to show my classmates some details. I had read that Vikings and Inuit are great examples of the problems global change can cause for humans. Since we had taken such great field trips in the past, it seemed almost natural that we were instantly transported to the site and the time. It was quite a spectacular backdrop to my presentation, if I do say so myself. Too bad that old Viking Bob had hitched a ride on the way back.

Mrs. Lucas interrupted my thoughts. "It would be much easier if we could just immediately return him to his own place and time, but now . . . Well, I'm afraid that's not possible since the principal wants to hear his presentation," she said with a sigh.

"Mrs. Lucas, he doesn't even speak English and there's no way he can deliver a presentation in class tomorrow!"

"Well, of course it's not going to happen that way," Mrs. Lucas replied, smiling. "But he still has to be here tomorrow."

The Viking began to play with a tassel on her shoe.

"What are we going to do in the meantime?" I asked.

"Well, I will make some plans for tomorrow's presentation," she said, then quickly added, "and you'll watch the Viking overnight and return with him to class tomorrow."

"I will?" I said.

"Well, it won't be easy," she continued. "But you can do it!"

I rose from my seat in complete shock. I had total care of this fifteenth century Viking for nearly twenty-four hours; he was going home with me overnight. The Viking stood, ready to follow me.

"You should go on home now," Mrs. Lucas said to me. "If you leave now, fewer students will see you in the hallway."

I glanced at the clock. She was right, of course. In the time we had been talking, most of the kids had already left. But in a half-hour or so, players, cheerleaders, coaches, and eventually fans would be heading back for a basketball game.

I took the Viking again by the greasy fur-covered forearm and pulled him along. We walked home very slowly. Luckily, my parents weren't home yet. As we sat on the couch, I toyed with the idea of getting this creature into the tub. He really reeked! But the sensible part of me took control. I couldn't give him a bath! What would it do to his personal ecosystem to suddenly have his personal microorganisms washed away? What would Greenland do without his "special" niche of wildlife? I laughed to myself as I thought about the "personal global change" a bath might cause him.

It dawned on me that it must be very warm for him here. He was dressed entirely in fur. He lived in an area of Greenland that was getting progressively colder. In fifty years or so, his descendants would be unable to live there; they would move on or die. Only the Inuit would figure out a way to continue to live there. I felt sorry for him. He was human, after all. His family was back in Greenland, probably wondering what had happened to him, already worried enough about poor crops and shortening growing seasons.

"How are you going to keep Bob here overnight and get him back to school tomorrow without your parents seeing him?" I asked myself. Somehow, I knew my parents weren't going to believe any story I could make up. Then it dawned on me: Why did they have to see Bob?

My friend Nathan came over, and we hatched a plan. "I'll get a few supplies; meet me with Bob at my old fort," I told him. My dad had built me one of those swing-fort combination sets when I was about seven. We'd never taken it down because in the summer, I still like to hide up there and read. It beats being available for every chore that comes around!

I made a peanut butter and jelly sandwich and grabbed some fruit from the 'fridge. Upstairs in my room, I found the heaviest spare blanket and a spare pillow. In the linen closet, I found an old plastic sheet that my younger brother had used. Perfect.

Bob and Nathan had already climbed up into the fort. Nathan looked very uncomfortable, but Bob seemed happy to be outside. He pointed up at the clear sky and some very strange words came out of his mouth. Nathan nodded. "He's been talking about the stars ever since we came up here. He seems fascinated with them."

I placed the plastic sheet on the floor of the fort. Then I spread the blanket and placed the pillow on top. Meanwhile, Nathan convinced Bob to eat the peanut butter sandwich and fruit. The fruit was easy, but Bob was more than a little reluctant to eat the sandwich. It took a few small demonstration bites before Bob tried it. Then he ate it in three large bites!

"I'd better stay with him until he falls asleep," Nathan volunteered. "My parents are going out this evening and won't be home until late."

"Great," I answered. "I appreciate that."

"No problem," he responded. "With the type of day he's had, he'll fall asleep early."

"I'll let you know when I get home. I'll call," he said.

About nine o'clock that night, I got a phone call. Nathan was home and Bob was sleeping soundly in the fort.

Now I just had to get to sleep, which meant that I had to put a lot of things out of my mind.

"What if Bob freezes to death out there in the cold? How would I explain a Viking kid to the proper authorities?" I thought. Then reason began to take over. Bob was from a much colder climate. He was dressed in fur and had a heavy blanket. I went on to another concern.

"How am I going to get Bob back to school without my parents seeing him?" It took some time to plan my strategy. I set my alarm for super early in the morning. Finally I went to bed.

The alarm went off and I sprang out of bed. I dressed quickly and quietly. Then I went into the kitchen, made myself a bowl of cereal, and looked around for something to give Bob for breakfast. I knew fruit was a safe bet, and since he had learned to eat a peanut butter sandwich, I thought a couple slices of toast with peanut butter and jam would be easy for him. Before I left the kitchen, I wrote a note telling my parents that I had gone to school early to work on a science project (not really a lie!).

When I got to the top of the ladder, Bob slowly opened his eyes and looked around. He actually smiled when he noticed me! I passed him the toast and fruit; he inhaled them.

I rolled up the blanket and the sheet and we left for school.

I had deliberately walked as slowly as I could, but we were still early. School wasn't open yet, so we had some time together. We sat at the front entrance, and Bob got chatty. He pointed out items and talked about them. But I wasn't sure if he was asking me something or telling me something. "Oh," I answered back a few times; eventually, he gave up, frustrated.

When the bell rang, Bob and I were the first inside. I immediately took Bob to the library. I knew that Mrs. Dickinson would help me out. I still had to get Bob through the entire school day. My science class was last hour!

Mrs. Dickinson was busy lining up audiovisual equipment. She continued working with her back to me, but said, "Hi. If you need something, just ask. My student assistants haven't come in yet."

"I need to ask you a favor," I said in my most sincere voice.

"Oh? And what might that be?" she asked as she swung around to see just exactly which of her several hundred students she might be talking to.

"Oh, my," she said when she saw Bob. "It's another science project, isn't it?" she guessed.

"Exactly, and one that could use your help." I smiled. I had gone to Mrs. Dickinson before. I think that she and Mrs. Lucas respect each other, and I believe Mrs. Dickinson knows some of the things that have happened in our science class.

"Well," she paused. "What can I do to help?"

"Do you think it's possible that Bob—I mean the Viking, here—could stay in the library with you for a few hours this morning, and . . . well . . . even the hour after lunch?" I asked.

"Hmmm," she said, as she considered the question. "You know that I don't allow students simply to sit in the library. He's going to have to be actively involved in research."

"No problem," I said. I had already thought about that. Bob could use a pair of headphones and watch videos. He could look at books and, with a little training, could surf the net. Since we had nearly a half-hour before school officially started, I could teach him to do these things. I started right in and, of course, Bob mimicked everything I did. He did seem genuinely astonished when music came into his ears, but he seemed to adapt very well overall. Just as a joke I showed him how to put his right index finger up to his mouth and say, "Shhh." I figured that'd be real useful in the library.

Well, it didn't take too long, and Mrs. Dickinson was right into helping me out. I told her I was going to tell students that Bob was a visiting professor, so it seemed logical that he would spend time in our library. Although she did remind me that it isn't a good idea to lie, she did admit that these were unique circumstances that made lying somewhat necessary. She ended the discussion with "But the end does not justify the means!" which I took to mean that I shouldn't lie again.

"Oh, dear, what about lunch? You can't take Bob to the cafeteria!" she said. "And the library is closed," she added.

Certainly true. I knew from experience that Bob probably could not eat much of the food served in our cafeteria. And the cafeteria workers do look at students; I would hate to have one faint in the mashed potatoes at the sight of Bob.

Mrs. Dickinson is one great lady. She said, "I'm going out for lunch. You and Bob meet me at the back stairwell on the south entrance and I'll bring you some food. I won't be long."

Well, the morning passed uneventfully. I got called on in math and didn't know the answer because I was thinking about Bob in the library. My world cultures teacher asked us to draw a relief map of Greenland, which I thought was hilarious. My English teacher asked us to write an essay. That's all. Un-eventful.

At the sound of the lunch bell, I dashed up to the library. Bob was sitting at a desk in the back. He had a book to his face and a headset from a CD player over his ears. When I got closer, I noticed he also had a huge grin on his face. He placed his right index finger to his lips and loudly said, "Shh!" It took all I could to keep from laughing at him.

Sure enough, Mrs. Dickinson met us about half an hour later at the back stairwell, south entrance. She had a burger and a shake for me, but a big salad and a small loaf of brown bread with cheese for Bob. Bob ate every morsel.

Then it was back to the library for Bob while I took one more class. That

class seemed to drag on endlessly as I grew more anxious about science class. The principal was coming in to see my presentation on the Little Ice Age, and we had to get Bob back to 1450 Greenland. Not just your typical science class, you know.

When the teacher dismissed us, I dashed through the hallway and up to the library as quickly as I could. Bob was sitting where I left him, but he was leafing gently through some travel magazine that had pictures of glaciers. I quickly motioned for him to follow, and he carefully placed the magazine on the periodical return pile. Then he followed me to science class.

Mrs. Lucas smiled at us as we entered. "Good afternoon," she said.

Most of the rest of the class was already seated. I found my usual place and pulled an empty desk close to mine for Bob. He sat quickly in the chair.

"As soon as our principal arrives for the presentations, we'll begin with the conclusion of Little Ice Age," Mrs. Lucas said, as she nodded in my direction. "Until then," she continued, "let's try a role-play that shows the complexity of global change."

Well, Suzy immediately stood up and started dividing the class into six groups. She let Bob and me be in the same group. Then she handed each group a slip of paper with a role. Bob and I were peasant farmers who needed to increase our amount of farmable land or face starvation. Other groups were conservation experts, agricultural ministries, economic experts, government officials, and hunters. One by one, each group told its side of the issue. Then the other groups asked questions. Soon there was a heated debate going. It quieted in a hurry when our principal walked in.

He greeted Mrs. Lucas, and she acknowledged him. "We can finish our presentation now."

The principal took the seat next to Bob. Mrs. Lucas continued. "Class, take three minutes to finish your discussion, then Suzy will take a vote on the topic."

Our discussion was somewhat more subdued after the interruption, but we continued. The vote was closer than I thought it would be, but it did eventually go in favor of preservation.

Soon it was clear that Mrs. Lucas was ready. I motioned to Bob to stand up. He reluctantly did so. When I turned around to face the class, he didn't. I had to put my hand on his fur-covered shoulder and turn him in the right direction. The computer made its familiar hum as I said to the class, "I'd like to show you some scenes that will help you think about the perils that humans faced because of global changes. For instance, Nathan's Daisy World program presentation showed the results of periodic warming and cooling trends. Lindsay showed the potential result of coastal flooding. Kyle showed how much land is needed for truly sustainable agriculture with the current world population. Now I'll show a people in direct competition with other peoples for resources.

"I want you to see Vikings and Inuit on Greenland during the period known as the Little Ice Age."

As I finished the last sentence, I clicked on the mouse and the big screen came to life. Mrs. Lucas had set it at the main screen for the atlas menu. I

clicked on Greenland. The voice synthesizer said "Greenland" as the screen zoomed in. A time line appeared on the large land mass. I moved my mouse to indicate the period from CE 1400-1500. "There is documented evidence of rapid cooling of Earth within this century. Since the cooling was neither as long nor as cool as other periods of extreme cold, it is known as the 'Little Ice Age.'"

I glanced at Mrs. Lucas. She held her head high and looked determined. I glanced at my audience. Most of the kids had a look of anticipation. Our principal looked extremely bored. And Bob had a quizzical look, as if he might have an idea that something was about to happen.

With extra emphasis, I clicked the mouse. The voice synthesizer calmly announced, "Greenland, 1450," and with a soft noise and great flash of white light, we were there and then. All of us—even our principal.

There was a momentary pause as the class checked our principal for a reaction. He had obviously gone from bored to at least mildly curious, but he didn't seem fully aware of the miracle that had happened. Suddenly he was aware that the class was checking him for a reaction, and he grew somewhat self-conscious. He quickly checked the zipper of his trousers. Then he cleared his throat. "Go on. Continue with the presentation, please," he said with amazing steadiness, considering the unique situation.

So I continued. "You can see how difficult farming has become for the Vikings, who were not the original natives of this region."

The voice synthesizer repeated dully, "Vikings were not native to Greenland. They were nomadic and traveled extensively throughout the northern hemispheres. They were basically farmers." A few Viking farmers could be seen checking the snow depth in the near distance.

"The winter season of extreme cold seemed to extend longer each year. Eventually, most Vikings were forced to move from Greenland, or they couldn't move and perished," I continued. At that point Bob spotted the other Vikings and signaled for them to come near.

The principal watched the Vikings. "It's amazing!" I heard him mumble beneath his breath. "They look so lifelike!"

As the other Vikings drew nearer, it was clear that Bob knew them. They grabbed him, hugged him, and his grin grew wider than I had ever seen it. He was clearly home. I continued.

"The Inuit were not as affected by the shortening of the growing season because they foraged for food in the ocean; their diet consisted mainly of seal and fish."

The voice synthesizer continued, "Inuit survived the Little Ice Age and their descendants still populate this region."

Suddenly, a different group of people became visible. The difference between the two groups was amazing. While the Vikings had fair skin, light eyes, and light hair and beards, the Inuit had dark skin, eyes, and hair. The Vikings had crudely sewn one layer of hides together for clothing. The Inuit wore more than one layer, and their sewing was more advanced, with few stitches showing.

Our principal's reaction to the sudden appearance of the Inuit was amazing.

He had accepted the Vikings and their peculiar approach from nowhere. Now he was obviously accepting the Inuit. He went over to a family and started to talk with them, leaving the class to wonder just exactly what he was up to.

Meanwhile, Mrs. Lucas reached into my hand and clicked twice on the right mouse button. I felt the now familiar tumbling sensation that signaled our return. Thump.

We were back. The voice synthesizer signaled our return with "Insufficient output. Warning! Insufficient output," which I thought meant we had left Bob behind.

I looked out at the familiar classroom and breathed a sigh of relief. Bob had been successfully returned to his time, country, and people. We had left him there. His chair was empty. I felt an overwhelming sense of satisfaction, along with a touch of sadness. I knew his ultimate fate and the fate of his family.

The bell rang. The rest of the class gathered their books and other belongings. It was then that I noticed that the seat next to Bob's was vacant, too. Our principal hadn't returned with us.

Mrs. Lucas said, "Class dismissed. See you all tomorrow. We'll finish two more presentations." The class filed out in typical noisy fashion.

"Mrs. Lucas," I said. "The principal didn't return with us!" My voice was charged with alarm.

"I know," she said calmly. "I'll take care of it, don't worry."

I walked slowly home.

First thing the next morning, I hurried into Mrs. Dickinson's library to thank her for her help with Bob. I'd brought her a thank you note that had an Inuit and a Viking on it. She gave me a great big smile when I gave it to her; she told me how she appreciated that I had remembered to say thanks. Then I asked her, "Have you seen Mrs. Lucas this morning?"

"Oh, sure, I heard her talking with the principal bright and early this morning," Mrs. Dickinson said.

"The principal was here this morning?" I gasped.

"Sure," Mrs. Dickinson continued. "He said he plans to turn up the heating system in the building today, have the cafeteria order more fresh fish, draw up some blueprints for a new portable shaped like an igloo, and—oh, of course—talk with Mrs. Lucas about enhancing her computer!"

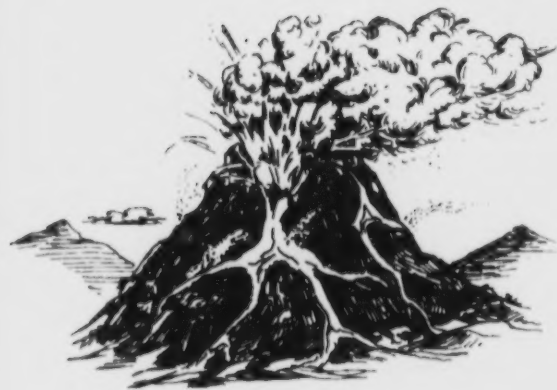
I smiled back at Mrs. Dickinson. She and I had just shared a secret that very few at school knew. All I could think of was how lucky I was.

Glossary

acid rain	precipitation with a low pH level caused by chemical dumping into water and air pollution; responsible for destruction of various forests in Europe and for health and environmental problems
agricultural	an adjective suggesting farming; includes cultivation of soil, planting of crops, breeding of animals, raising of livestock, dairying, and forestry
carbon dioxide	a gas emitted into the atmosphere mainly by cars; contributes to greenhouse effect
conservation	a multiple-use ethic that allows for wise, planned use of natural resources, including soils, water, plants, animals, and minerals
Darwin	British scientist (1809 to 1882) who advanced theory of natural selection, with the general idea that more organisms are born than actually survive to reproduce; those organisms that survive to reproduce pass the traits that helped them survive to the next generation of the species
Daisy World	computer program: a computer program used by James Lovelace to model Earth's temperature regulation system, which arises automatically due to feedback loops between the planet's organisms and their environment
deforestation	removal of plants, particularly trees, by cutting or burning large tracks of forests; crop land is often increased by removing trees
ecosystem	a collection of organisms and the physical environment that surrounds them, including the cycling of nutrients and energy
El Niño	the shortened version of "El Niño-Southern Oscillation," also sometimes referred to as ENSO; originally observed by Gilbert Walker in the early 1900s
Gaia	named for the Greek goddess of the Earth, James Lovelock's hypothesis that the Earth is a living system; based on the fact that all living systems take in energy and matter and discard waste products
glaciers	immense ice sheets, often thousands of feet deep and many miles long, flowing very slowly over land they cover and gouging rock formations beneath them
greenhouse effect	a property of the Earth's atmosphere in which light rays from the sun pass through the Earth's atmosphere and strike the Earth, warming the ground; gases in Earth's atmosphere allow the sunlight to pass through but trap heat and prevent it from escaping back into space

Greenland	the largest island in the world, situated between the North Atlantic and the Arctic Ocean, with most of it lying above the Arctic Circle; interior areas are covered by ice
global change	a change in the current life-sustaining conditions on Earth that may be manifested as changes in weather, changes in climate, and dramatic environmental changes to the planet Earth
global warming	see "greenhouse effect." Global warming is a more generic term for the warming of the planet and the greenhouse effect details how this warming might be taking place
habitat destruction	the devastation or ruination of the places where an organism lives
Ice Age	a period within the history of the planet in which significant cooling took place; the last ice age began about 2.5 million years ago in the Quaternary Age
Inuit	the people of Mongolian ancestry who live in the Arctic Circle
Little Ice Age	recorded in the Greenland ice as having begun between CE 1400 and 1420
Mendel, Gregor Johann	an Austrian monk (1822 to 1884); known as the father of modern genetics because of his research with the inherited characteristics of pea plants
methane	a very common natural gas, lighter than air, colorless, odorless, and flammable; amount of methane in the atmosphere seems closely tied to temperature fluctuations
microorganisms	organisms of microscopic size; includes such organisms as bacteria, protozoa, algae, fungi, and viruses
niche	the full range of physical and biological conditions in which a species can live and reproduce
ozone depletion	the removal of the ozone layer in the upper atmosphere, which protects Earth from excessive ultraviolet radiation from the Sun
pollution	The introduction of a substance with which the ecosystem has no evolutionary experience; therefore the substance tends to accumulate and can disrupt the functioning of the ecosystem
population control	the control or monitoring of the number of individuals of a single species
preservation	a philosophy of maintaining an ecosystem at a natural state with little or no intervention
tropical rain forests	forests that exist within ten degrees of the equator and are characterized by having a wide diversity of plants and animals
volcanic eruptions	the ejection of material from volcanoes

Global Change

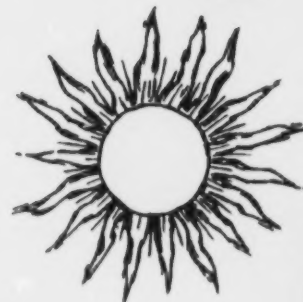


How Humans and Nature Impact Our Planet

Name _____ Date _____

Unit 1

1. Setting the Stage



Think of pictures you have seen of Earth.

Think about the different colored parts.

Blue parts. White, swirly parts. Yellow parts.

Brown parts. Beautiful parts, all.

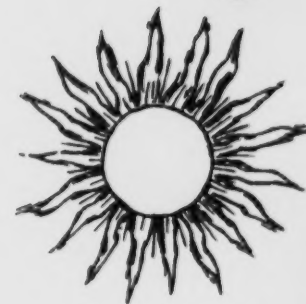


◀ **Draw a picture of
the beautiful Earth.**



2. Global Creations

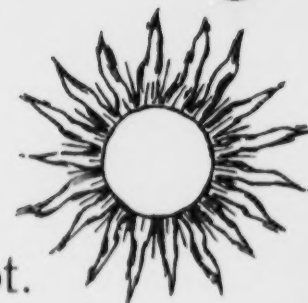
Use a large balloon. Cover it with papier mâché and let it dry. Paint the blue parts. Then paint the brown, green, yellow, white, and other colored parts.



**Use your globe
to tell your class
about Earth.**



3. Running Hot and Cold



Earth's climates and temperatures have changed a lot.

Find out about ice ages.

Find out about warming trends.



Make a time line that shows the ice ages.



Draw pictures on your time line.



4. Volcanoes, Tornadoes, and Earthquakes, Oh, My!

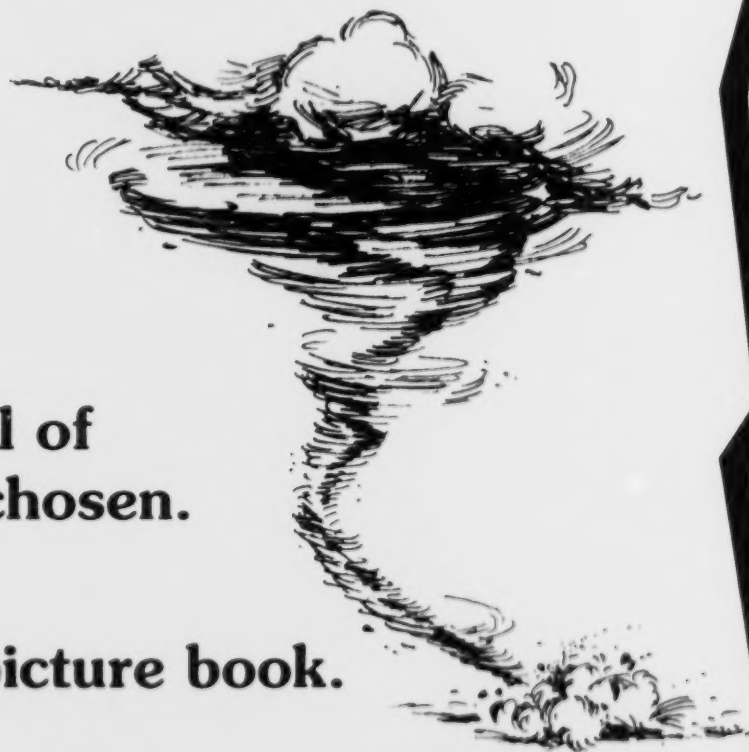


Find out about volcanoes, tornadoes, and earthquakes.
What causes them? How do they affect climate and weather?

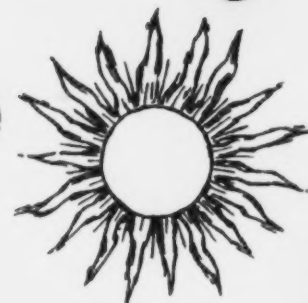
► **With some friends, write a play that shows what happens when one of these occurs. Perform your play for your class.**

or **Make a model of what you've chosen.**

or **Make a picture book.**



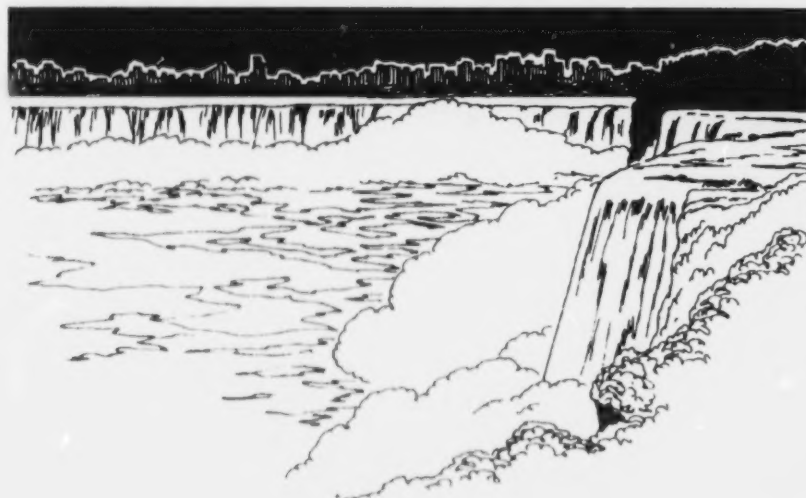
5. Water, Water Everywhere



Find out about the various states of water.

Where does each exist in nature?

► **Create a model
to teach your
classmates what
you have learned.**

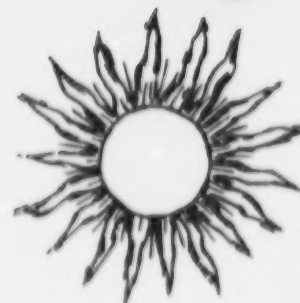


or

**Show your class how one
state becomes another.**



6. Viking Bob: The Mural



Read or have someone read to you the story in this learning packet.

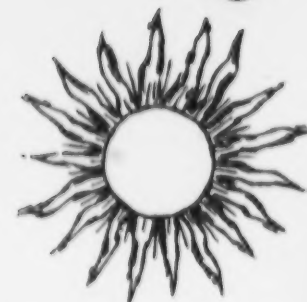
▶ With some friends, create a mural of the story.

▶ Each of you choose a scene in the story.

▶ Put your mural up in the classroom.



7. Popping Up with Global Change



Find out about one of the following.

glaciers

dinosaurs and their extinction

dams

global warming



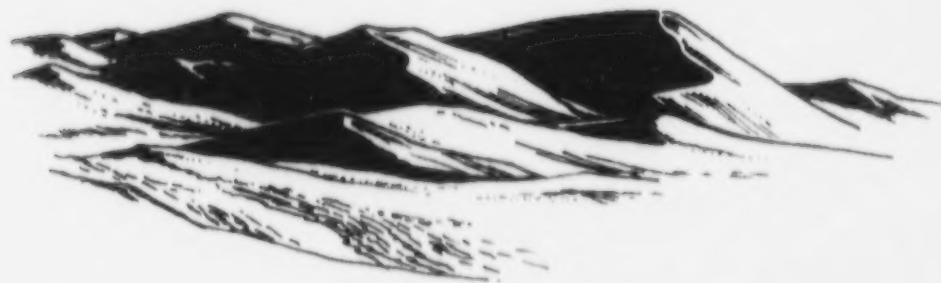
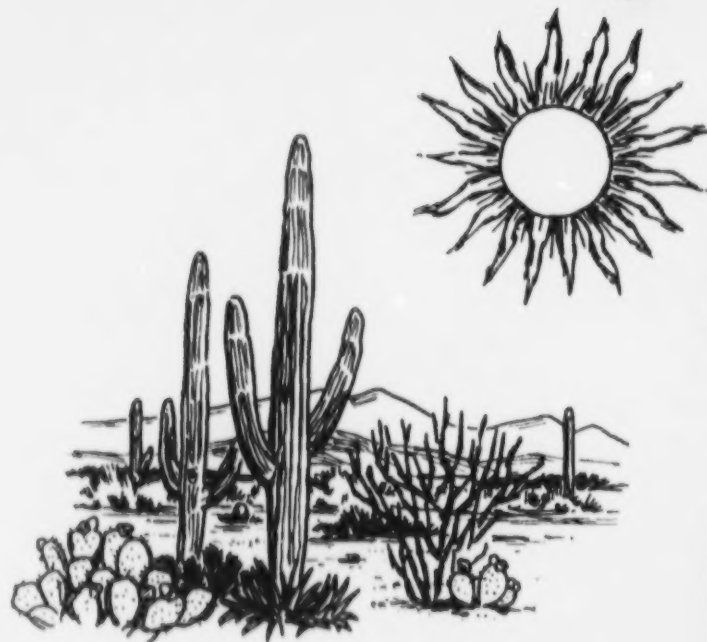
**Make a pop up book
that explains your topic.**

8. Growing Deserts

What is a desert?

Where do they occur naturally?

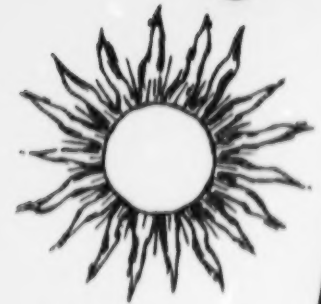
► **Draw a picture
of a desert.**



► **Tell your class how the world makes one.**



9. Folk Tales, Myths, and Legends



Read or have someone read to you “The White Buffalo Calf Woman and the Sacred Pipe.” Or read another American Indian story about Earth. You may also choose a story from the Aboriginal, Sami, Celtic, or another culture.

► **Illustrate the story in a comic book.**

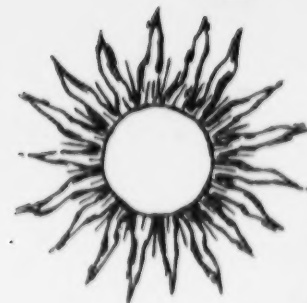
or **Tell this new story to your class.**



or **Rewrite your story as a play. With a few classmates, put on your play.**

10. Air Pollution

Find out what air pollution is. Is there any in your area?



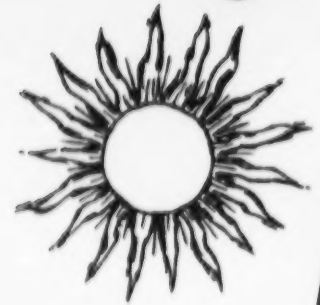
► **Write a song about air pollution.
Tell what it does to people.**

or

**Write about a
way to clean up
air pollution
where you live.**



11. Energy



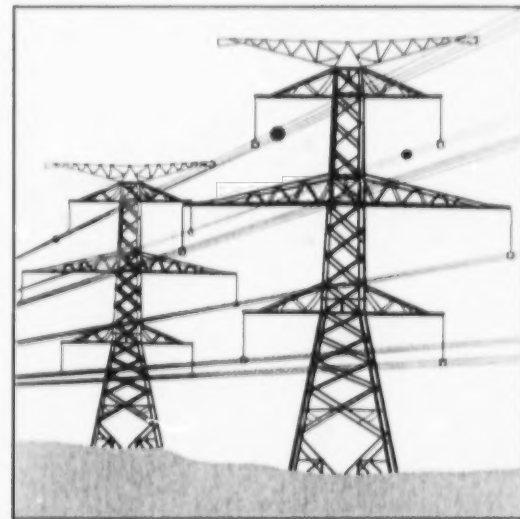
Think about ways your family uses energy.

For one week, watch your family and how they consume energy.

Note your findings in an energy journal.



**Create a comic book
that tells your family
ways to save energy.**



12. Searching for Puzzling Words

Use words associated with global change to make a crossword puzzle or a word search. Or solve the word search and crossword puzzle provided.

The following words, terms, and phrases are hidden in the puzzle.

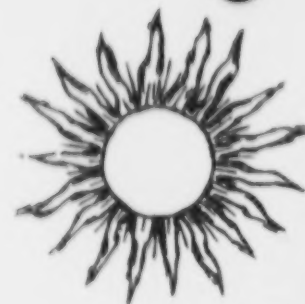
acid rain
atmosphere
carbon cycle
carbon dioxide
cfc
climate
climatology
coastal flooding
deforestation
emissions
glaciers
global change
global warming
greenhouse effect
ice ages
methane
ozone
pollution
rain forests
sulfur

Global Change Word Search

B	T	H	L	A	X	H	H	E	Q	P	V	K	T	H	Y	W	D	Z	T
Y	I	C	G	P	C	P	B	I	Y	Y	N	E	W	W	V	J	R	B	E
J	P	Z	E	O	Q	O	E	A	M	G	L	I	C	T	O	I	U	F	C
I	S	E	J	F	R	G	A	G	T	O	O	B	A	P	V	M	F	T	U
C	C	T	D	W	F	Y	E	S	N	M	Z	L	B	R	X	H	L	H	D
N	A	E	S	I	G	E	N	M	T	A	O	O	O	D	D	Y	U	V	Y
O	M	R	A	E	X	N	E	E	I	A	H	S	N	T	Z	I	S	L	L
I	U	E	B	G	R	O	I	S	T	S	L	C	P	E	A	M	C	E	B
T	U	C	T	O	E	O	I	M	U	A	S	F	L	H	A	M	C	A	S
U	T	F	U	H	N	S	F	D	R	O	M	I	L	A	E	C	I	X	U
L	X	C	F	P	A	C	Z	N	N	A	H	I	O	O	B	R	V	L	I
L	E	Z	B	B	T	N	Y	D	I	O	W	N	L	N	O	O	E	G	C
O	Y	X	Q	G	S	H	E	C	D	A	B	L	E	C	S	D	L	P	E
P	Y	P	F	S	L	B	K	U	L	M	R	R	A	E	C	Z	I	G	F
W	G	V	S	J	X	N	X	H	E	E	H	K	A	B	R	T	D	N	G
D	E	F	O	R	E	S	T	A	T	I	O	N	E	C	O	G	W	P	G
T	G	L	A	C	I	E	R	S	I	O	N	I	U	Y	I	L	J	Q	Y
Z	L	I	E	Q	W	M	X	F	D	R	K	R	E	Q	P	B	G	H	P
V	D	V	Y	A	B	T	D	V	P	P	V	L	B	S	G	F	C	T	U
W	K	G	C	T	R	T	X	N	Q	W	W	T	V	U	T	I	N	U	X



13. Writing, Singing, Painting



► Write a poem about something you have learned about global change.

or

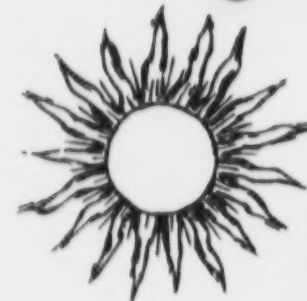
Write a song about energy. In your song, tell people some good ideas about saving energy.

or

Create a diorama that shows air pollution.



14. Farming, Farming



Interview a farmer. Write questions ahead of time.
How has farming changed in the last 25 years?

► **Report your findings to your class.**
Use pictures, words, and other aids.

or Invite a farmer to
talk to your class.

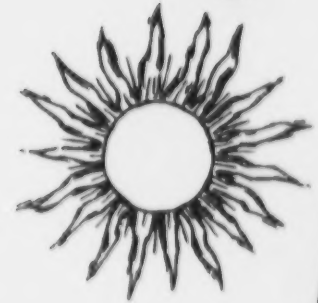


or

Arrange a field trip to a farm.



15. Games



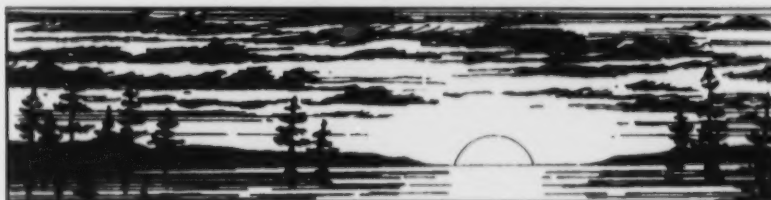
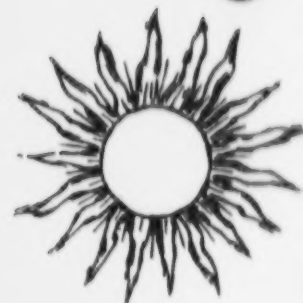
Make a global change game.



Use what you have learned in this unit.



16. Global Change Day



**With your classmates and teacher,
schedule and plan a celebration day.**



**Create a museum, prepare some
food, dress in costumes that reflect
what you have learned.**



Use your imagination.



Invite other classes to participate.



Global Change



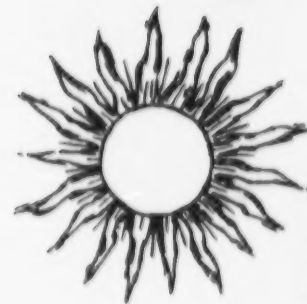
How Humans and Nature Impact Our Planet

Name _____ Date _____

Unit 2

1. Setting the Stage

Research various American Indian, Aboriginal, or other similar views of the environment.

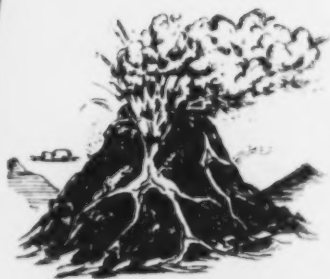


► **Write a report that details their views.**

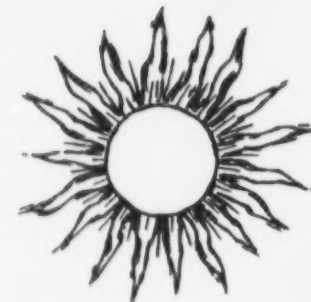
or

Research Celtic or other cultural references to Mother Earth. Find as many examples as you can.

► **Draw Mother Earth based on the descriptions you have read. Show your illustration to the class; describe the characteristics of Mother Earth.**



2. Global Creations



Use two large balloons the same size to represent two globes. Cover the balloons with papier mâché and let dry. Paint the blue ocean on each first. On one, paint the continents to scale as they are now with brown or green paint. On the other, paint the continents as they might be if polar melt causes massive coastal flooding.

or

▶ **Use both globes to give a presentation to your class.**

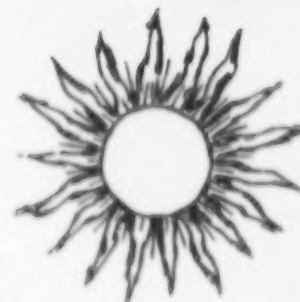
Prepare only one balloon globe. Cover another, smaller balloon with papier mâché and paint it gray to represent an asteroid. Use the balloons to explain the asteroid theory of the mass extinction of the dinosaurs.



▶ **Act out the collision for your class using your props. Make sure you explain the relationship between the collision and the extinction.**

3. Graphing Change

Check out major search engines on the Internet using the phrase "global change." You might see such sites as the Global Change Research Program, the Global Change Research Center (Portland State University), the National Institute for Global Environmental Change, NASA's Goddard Institute for Space Studies, and the EPA's Global Warming Site. Find data that you can graph or graphs prepared for you at these sites.



Prepare an oral presentation about the most recent findings on global change.

or

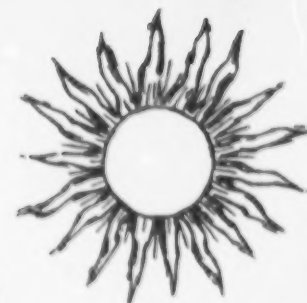
Compare the information about global change presented in three major CD-ROM encyclopedias. Analyze the articles. Do they refer you to other articles? Do they contain any contradictory information? Do they cite any specific research? What credentials does the author who wrote the article have?



Prepare a chart for your class that shows the differences in data and presentation among the three encyclopedias you researched.

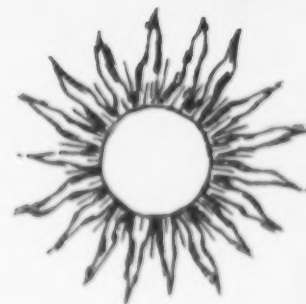
4. Running Hot and Cold

Earth's climates and temperatures have gone through several cycles of warming and cooling. Find out about these natural cycles.



Create an illustrated time line of these warming and cooling trends.

5. Running Hot or Cold?



Earth's temperatures are changing. Many scientists believe the change is due to human activity that affects the ozone layer. Others believe it is due to the onset of the next ice age or a cooling trend.

Research both sides of this issue.

- ▶ **In an illustrated chart, pictorial web, or visual flow chart, show the theories and the evidence for each.**

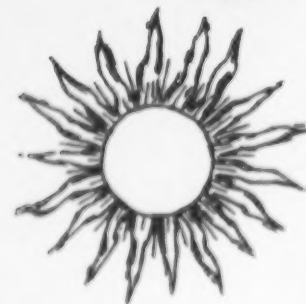
or

- ▶ **Set up a debate with friends. For added interest, argue for the side you *don't* agree with.**



6. Wintry Debate

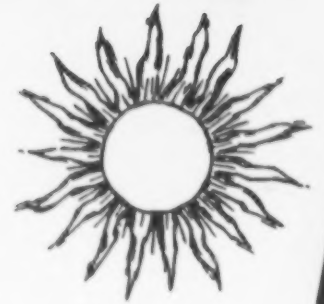
Many scientists cite harsher winters in some areas of the world as evidence that global warming is not occurring. Others say those winters are part of the same problem. Find out about both sides of the issue, including the scientific evidence on which each side depends.



Write an illustrated children's book that shows the two sides of the issue.



7. Catastrophic Benefits



Find out about one or more of the following. What causes them? What changes in Earth's structure do they make? What do they destroy? What do they build or create? How do they affect climate and weather? Soil? Ocean currents?

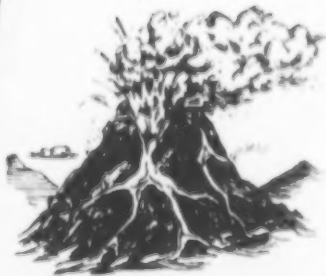
volcanoes
tsunamis

earthquakes
El Niño

tidal waves

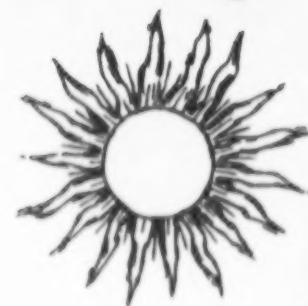
▶ **With some friends, write a play that shows what happens when one of these occurs. Perform your play for your class.**

or



▶ **Make a model of your natural catastrophe. Be sure to show the effects it has on Earth and the climate.**

8. Climatic Changes



Find out about the hydrological cycle. What is it? How does it work? Then find out about one of the following. Does your topic affect the hydrological cycle? If so, in what ways? Is your topic the result of a disruption in the hydrological cycle? Discover the causes, the current effects (what has already happened to the area), and the projected effects (what will happen down the road).

flooding in Bangladesh

monsoons moving out over the ocean instead of falling on land

dams and other diversions of waterways

water pollution

oil spills

ground water depletion

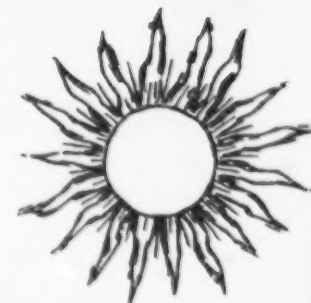


▶ **Create a model
or plan a field trip
to show your
classmates what
you have learned.**

or

▶ **Invite a water
expert into your
class to discuss
the long-term
effects of the
topic you chose.**

9. A Different Point of View

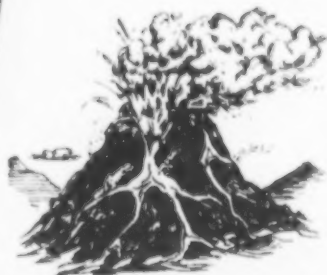


Write Viking Bob's perspective of his adventure. Use the format of a journal and write his adventures beginning with his view of the class at his Greenland site through his return and include the principal's time in Greenland.

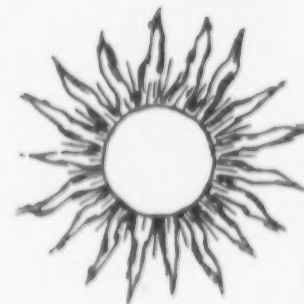
or



Write a report about the use of the computer in the science class from the principal's view. What would he tell the school board about his trip to Greenland? What did he see and do there? Since he made some changes to the school that reflected his sojourn in Greenland, his experience must have been positive.



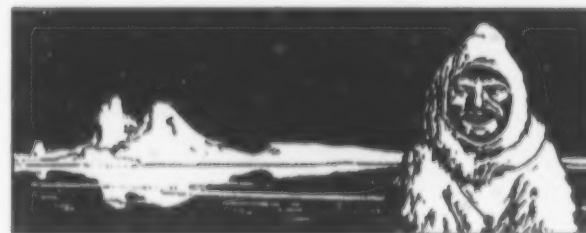
10. Comparing Cultures



Compare the Inuit lifestyle with the Norse lifestyle. Why did the Inuit thrive in Greenland while the Vikings had to move or die off? Speculate based on your findings.

or

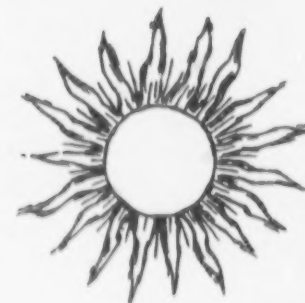
Compare the lifestyles of peoples who live near the rain forests with your lifestyle.



Prepare a chart that illustrates some of the differences in the lifestyles you researched.



11. Industrial Revolution



Research the effects of the industrial revolution. What was Earth like before the revolution? How and where has it changed? What specifically are the causes of these changes?

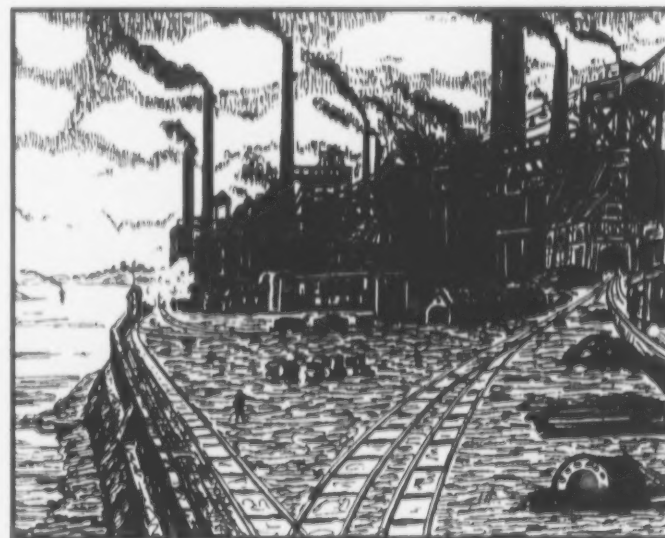
► **Create a before-and-after poster that shows the global effects of the industrial revolution.**

or

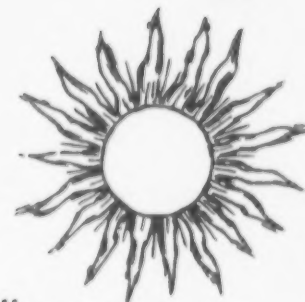
Put on a before-and-after skit that shows animals, plants, and people's lives before the revolution and after the revolution.

or

Write a song that depicts the changes.



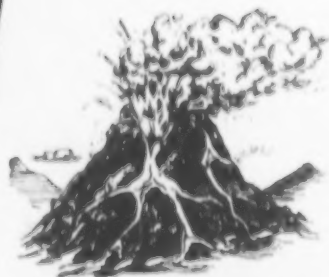
12. Stopping another Revolution



Peoples who have traditionally lived near the rain forests are usually very poor by American standards. They might have a very different view from that of environmentalists about deforestation. In many cases, cutting down areas of the forest for a corporation or to plant subsistence crops means the difference between starvation and eking out an existence.



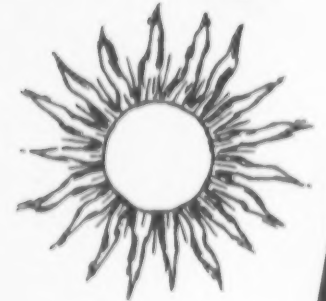
Prepare and conduct a debate on the statement below. You might disagree with it. Or you might agree with it but think it's okay that environmentalists do prevent such an event.



Environmentalists prevent nonindustrialized countries from developing into industrial societies.



13. Popping Up with Global Change



Research one or more of the following topics.

depletion of the ozone layer

the greenhouse effect and global warming

rain forest deforestation and sustainable agriculture

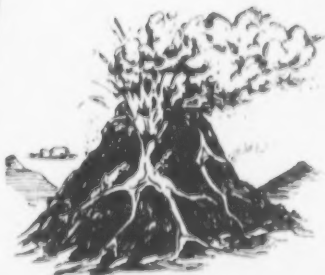
glaciers and ice ages

polar melting and coastal flooding

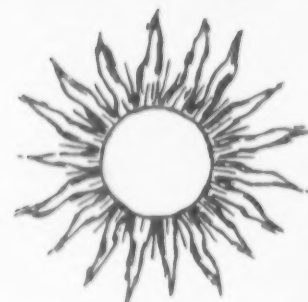
Make a pop up book that explains your topic.

or

Make a poster that shows Daisy World computer models. Show at least the four well-known results and tell the class how the model logically progresses from one to another.

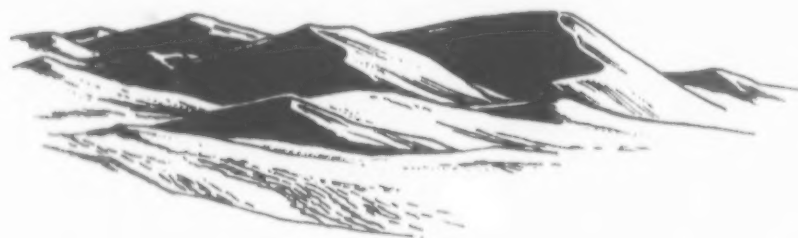


14. Desertification

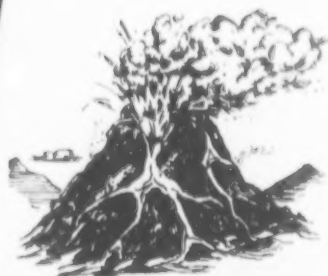


Find out what *desertification* means. In what areas of the world is it occurring? Is it natural? Caused by human activity? Both?

Choose one geographic area in which desertification is occurring. Calculate the rate per year.



▶ **Graph your findings. Show how much of the area will be desert in one year, five years, and ten years.**



15. Chemicals and Earth

Find out about the chemicals in the list below.

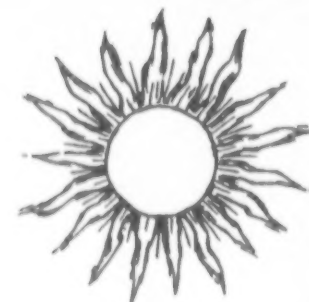
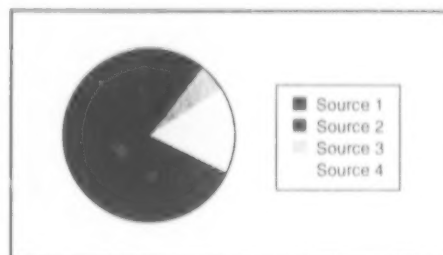
CO_2

CFCs

methane

nitrous oxide

ozone

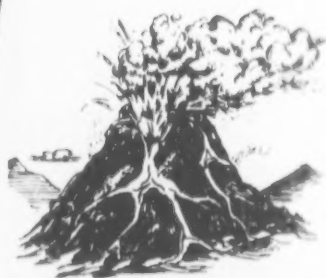


Prepare a pie graph that shows the influences of the chemicals on the greenhouse effect. When you present your pie graph to the class, list sources of the chemicals. With classmates, brainstorm ways to reduce these chemicals in the atmosphere.

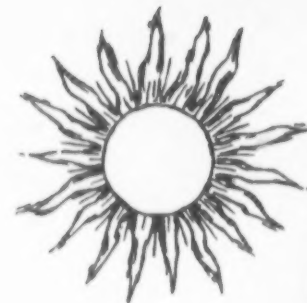
or

Review the rules of brainstorming with your class.

Brainstorm a list of causes of global change. Once you have a lengthy list, evaluate it for quality and choose six major causes. When you have six causes, brainstorm a list of practical solutions to slow or eradicate each cause.



16. Folk Tales, Myths, Legends, and the Environment

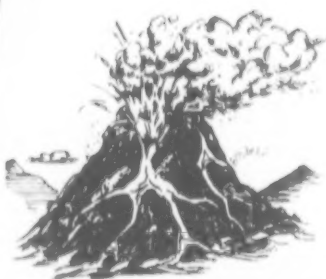


Read “The White Buffalo Calf Woman and the Sacred Pipe,” or another American Indian story that suggests interconnectedness among all elements of Earth. You may also choose a story from the Aboriginal, Sami, Celtic, or another culture.

► **Illustrate your story in a comic book, storyboarding each scene carefully.**

or

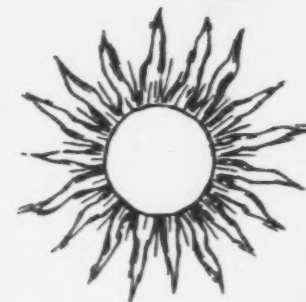
Tell this new story to your class as if you were a storyteller from the culture.



or

Rewrite your story as a play. With a few classmates, put on your play.

17. Greenhouse Experiments



Build a “greenhouse” using an empty glass aquarium with a piece of glass as a cover. Place a thermometer in the greenhouse. Use an identical aquarium without a glass top. Set both next to each other in the sun.

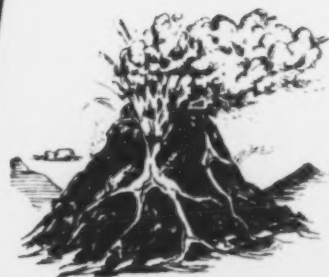
► **Design and conduct a few experiments with your greenhouse in which you answer the following questions:**

Do the two greenhouses have the same internal temperature?

How long does it take for any temperature difference to show?

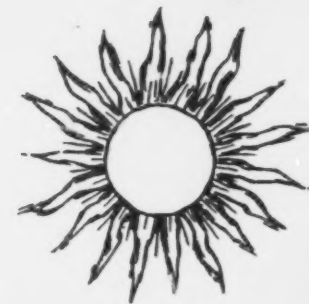
Would it make a difference if the aquariums had soil and plants in them?

What would be the long-term effect on the plants in the “greenhouse” aquarium if both aquariums were kept in direct sunlight?



Present your findings to your class in an oral report.

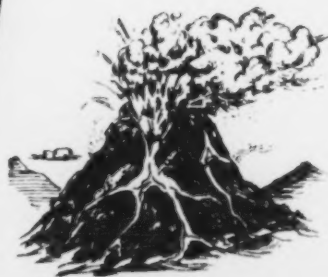
17. Greenhouse Experiments (continued)



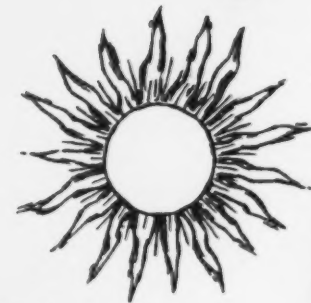
or

Research the atmospheres of the two planets closest to Earth. What is the atmosphere like on Venus? Why is the atmosphere there sometimes referred to as “the greenhouse effect gone wild”? What is the atmosphere like on Mars?

► **Make a chart that compares the compositions, the surface temperatures, and the densities of the three atmospheres.**



18. Air Pollution



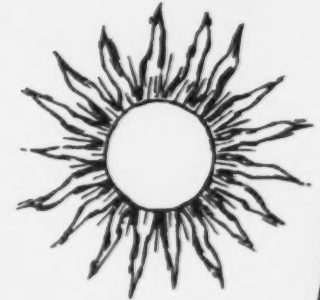
Investigate air pollution in your area. Make a grid of square centimeters on a sheet of paper. Make copies of this grid. Laminate each copy. Choose at least three areas that you think might have significantly different numbers of air-borne pollutants. You might choose a busy street corner near your school, an area inside your school building that has heavy foot traffic, an area inside your school building that has less foot traffic. Put petroleum jelly on each of the grid papers. Hang the grid papers in the chosen spots for at least one week. Count the square centimeters that obviously have materials on them. Do the results differ from location to location? Why or why not?



Report your findings to your class, using the grid paper to illustrate your conclusions. Suggest reasons for the different results. With your class, choose a project to reduce the pollutants in at least one of your chosen areas.



18. Air Pollution (continued)



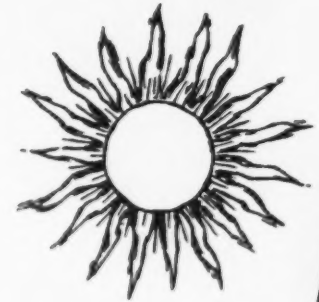
or With the help of an adult, place a coffee filter on a car exhaust pipe. Attach the filter to the exhaust pipe when the pipe is *cool!* Then ask the adult to run the car for 5 minutes in a well-ventilated area. Let the exhaust pipe cool before you remove the filter. Test the pH of distilled water. It should be seven. Take the coffee filter that was on the car and place it in 150 ml of the distilled water that you have tested. Take another coffee filter (of the same type and size of the one on the car) and place it in 150 ml of distilled water that you have tested. Test the pH of the water with the filters. Do the pH numbers differ? Why? What can you conclude about car emissions?



► **Prepare a lab report on your findings; read it to the class.**



19. Energy and Appliances

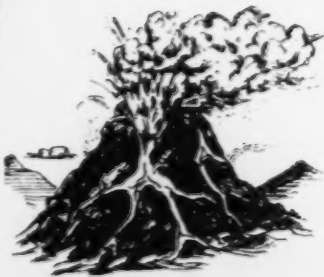


The EPA estimates that by the year 2000, energy use standards on appliances in a typical American home will have reduced national electricity consumption by 3 percent.

- ▶ **List other ways that national electricity consumption could be reduced.**

or

- ▶ **Prepare an appealing appliance advertisement that highlights this lower energy consumption. You may videotape it as a commercial, storyboard it as a commercial, or do a simple magazine advertisement.**



20. Searching for Puzzling Words

Use words associated with global warming to make a crossword puzzle or a word search.
Or solve the word search and crossword puzzle provided.

The following words, terms, and phrases are hidden in the puzzle.

acid rain
atmosphere
carbon cycle
carbon dioxide
cfc
climate
climatology
coastal flooding
deforestation
emissions
glaciers
global change
global warming
greenhouse effect
ice ages
methane
ozone
pollution
rain forests
sulfur



Global Change Word Search

B	T	H	L	A	X	H	H	E	Q	P	V	K	T	H	Y	W	D	Z	T
Y	I	C	G	P	C	P	B	I	Y	Y	N	E	W	W	V	J	R	B	E
J	P	Z	E	O	Q	O	E	A	M	G	L	I	C	T	O	I	U	F	C
I	S	E	J	F	R	G	A	G	T	O	O	B	A	P	V	M	F	T	U
C	C	T	D	W	F	Y	E	S	N	M	Z	L	B	R	X	H	L	H	D
N	A	E	S	I	G	E	N	M	T	A	O	O	O	D	D	Y	U	V	Y
O	M	R	A	E	X	N	E	E	I	A	H	S	N	T	Z	I	S	L	L
I	U	E	B	G	R	O	I	S	T	S	L	C	P	E	A	M	C	E	B
T	U	C	T	O	E	O	I	M	U	A	S	F	L	H	A	M	C	A	S
U	T	F	U	H	N	S	F	D	R	O	M	I	L	A	E	C	I	X	U
L	X	C	F	P	A	C	Z	N	N	A	H	I	O	O	B	R	V	L	I
L	E	Z	B	B	T	N	Y	D	I	O	W	N	L	N	O	O	E	G	C
O	Y	X	Q	G	S	H	E	C	D	A	B	L	E	C	S	D	L	P	E
P	Y	P	F	S	L	B	K	U	L	M	R	R	A	E	C	Z	I	G	F
W	G	V	S	J	X	N	X	H	E	E	H	K	A	B	R	T	D	N	G
D	E	F	O	R	E	S	T	A	T	I	O	N	E	C	O	G	W	P	G
T	G	L	A	C	I	E	R	S	I	O	N	I	U	Y	I	L	J	Q	Y
Z	L	I	E	Q	W	M	X	F	D	R	K	R	E	Q	P	B	G	H	P
V	D	V	Y	A	B	T	D	V	P	P	V	L	B	S	G	F	C	T	U
W	K	G	C	T	R	T	X	N	Q	W	W	T	V	U	T	I	N	U	X

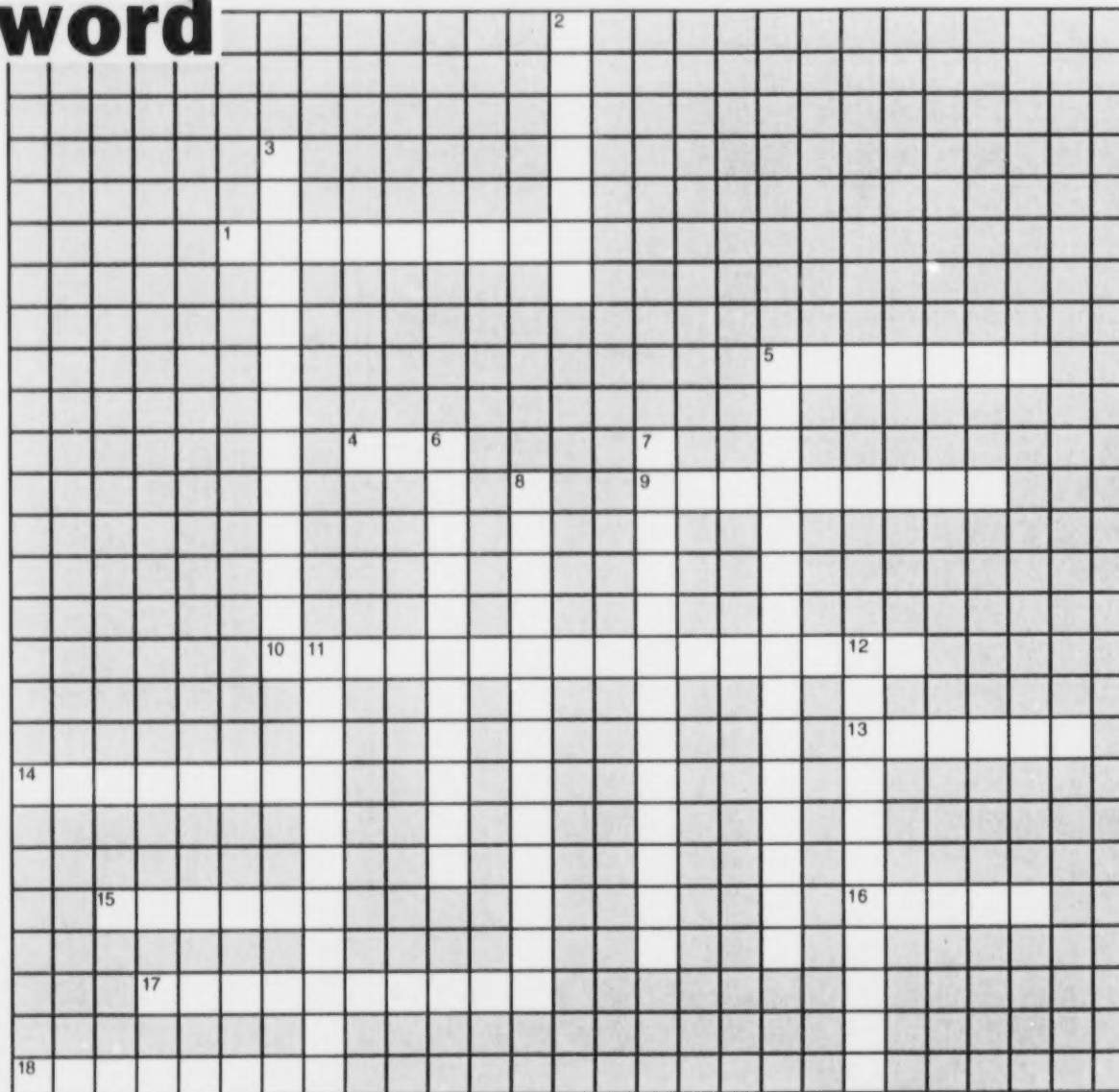
21. Crossword

ACROSS

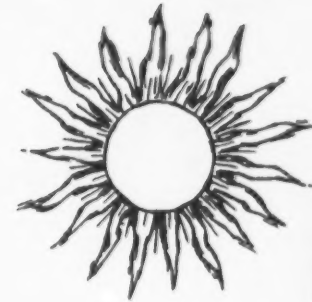
- 1 Dirties the air, water, and land
- 4 Comes from aerosol cans
- 5 Pattern of weather
- 9 Your car puts these into the atmosphere
- 10 What happens when there's trapped heat
- 13 Period of time of extreme cold
- 14 Precipitation with a low pH
- 15 Gas emitted by volcanoes
- 16 A form of oxygen
- 17 The layer of gases above a planet
- 18 These covered land during ice ages

DOWN

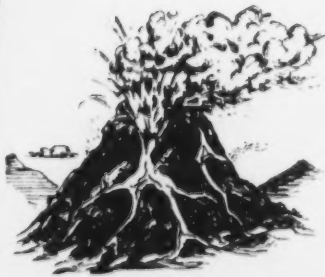
- 2 Rice fields and cows produce this gas
- 3 Worldwide temperature increase
- 5 May happen if temperatures increase
- 6 The recycling of an element in nature
- 7 The widespread removal of trees from an area
- 8 Builds up in atmosphere
- 11 Large green areas near the equator in Africa, South and Central America
- 12 Study of the total weather pattern



22. Medicines and Plants



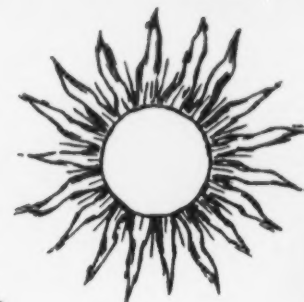
Research a medicine that is made from a plant found in the rain forest. How was the plant discovered? How many people has this medicine helped? How many rain forest plants have yet to be tested for their medicinal potential? What is the current rate of extinction for rain forest plants?



► **Prepare a written report of your findings.**



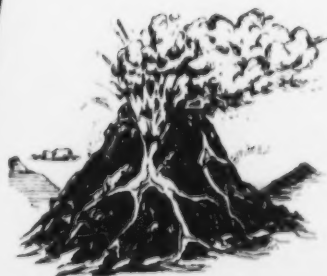
23. Writing, Singing, Painting



► Write a poem about an environmental issue that involves global change. Your poem might be about acid rain, deforestation, the greenhouse effect, agricultural practices, or any other environmental issue.

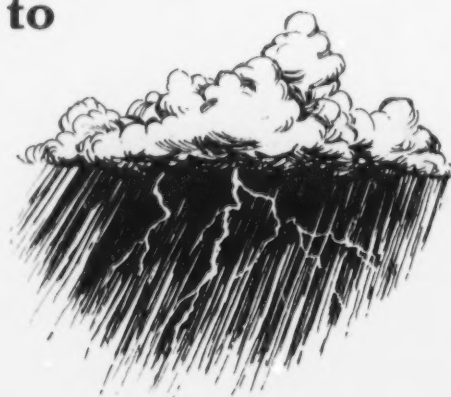
or

Write a song about energy. In your song you might be able to instruct people in some good ideas to conserve energy.

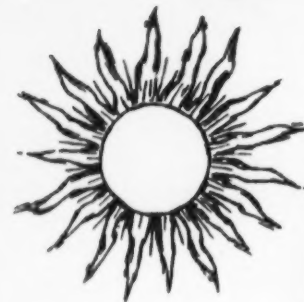


or

Create a diorama that illustrates the Black Forest of Germany or some other area that is affected by heavy pollution. Use the diorama to show your class how that area can be saved.



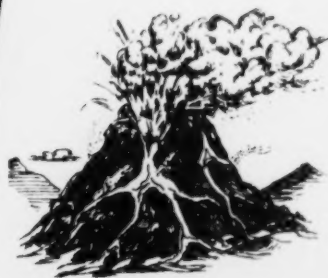
24. Modeling



► Build a solar-powered model. It could be a car, plane, or any other useful item. In an oral report to your class, detail the positive aspects of your model and the obstacles that might prevent it from being used.

or

► Design a scavenger hunt that shows your classmates where energy is being used at your school and the types of energy being used. You might give clues to places within the building where energy is used and ask your classmates to go to those areas and evaluate the current energy use. Would another form of energy be more efficient?



25. Comparing Maps

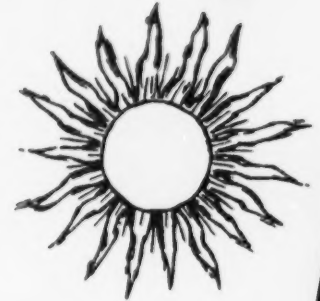


Make maps of the world that show the rain forests as they existed

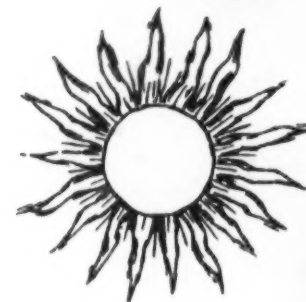
*five hundred years ago,
two hundred years ago,
one hundred years ago,
and as they are today.*



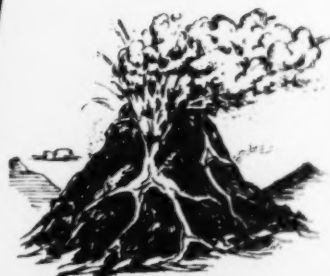
Show them to the class and report on the current rate of rain forest deforestation.



26. Inventions

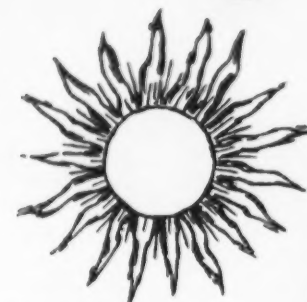


Investigate five very recent inventions just hitting the market. How environmentally friendly are they? Is their packaging environmentally friendly? Could they benefit the environment in some way?



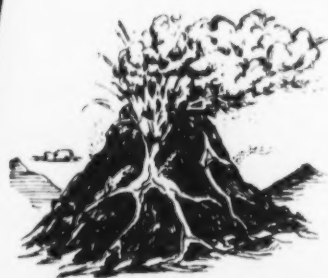
► **Make a chart that shows the results of your research. Propose modifications that would alleviate any environmental problems the invention might cause.**

27. Women Environmentalists



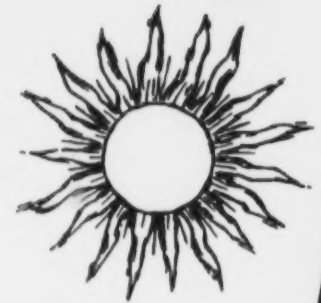
Investigate women's contribution to the environmental movement. How have women been involved in changing the view of Earth? Research one of the women scientists listed below, or choose a woman not on the list.

Florence Bascom (1862–1945)
Rachel L. Carson (1907–1964)
Winifred Goldring (1888–1971)
Hildegard of Bingen (1098–1179)
Maria Sibylee Merian (1647–1717)
Ynes Mexia (1870–1938)



Create an award that reflects the contribution of the woman you have researched.

28. Politics and the Environment



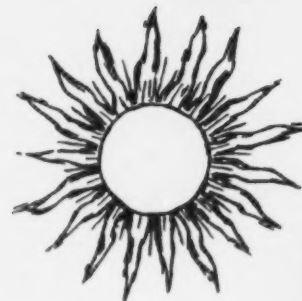
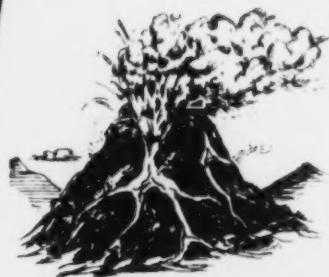
Find out about a national, state, or local environmental problem that will be affected by current national, state, or local legislation. How will the legislation affect the problem?

► **Write a letter about the problem and your position on the legislation to the appropriate person:**

***U.S. Senator,
U.S. Representative,
or state or local official.***

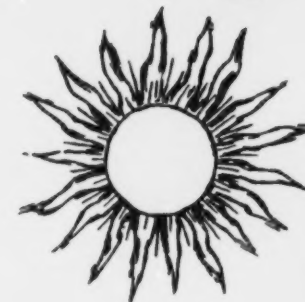


29. Games



Make a global change game board. Use your knowledge of the issues to make cards and pieces to accompany it. Use realistic environmental problems and successes to represent the advances and setbacks within your game.

30. Presenting Global Change



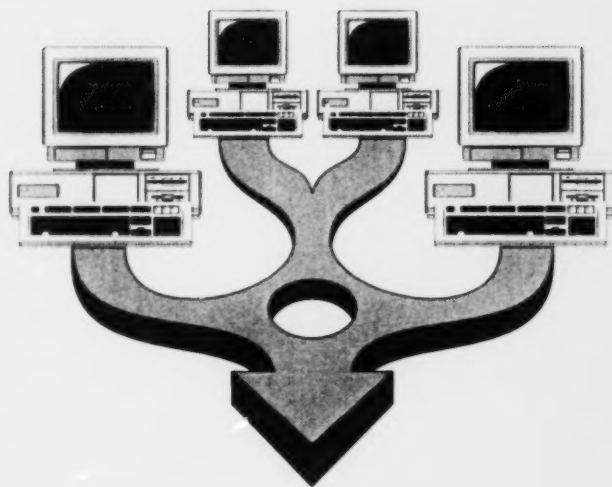
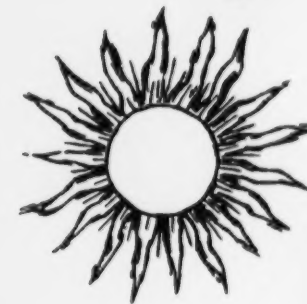
► Make a computer presentation using Microsoft PowerPoint or other presentation software about one global change issue. It might be about acid rain, rain forest deforestation, volcanic emissions, El Niño, methane from rice fields, or any other global change topic.

or

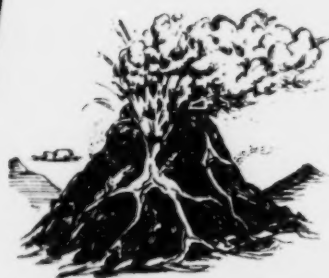


Create a web page of your class's computer presentations. Tie together student papers that address a specific theme or issue. Then link the papers appropriately. Use your web page to show the relationships among all the topics.

31. Global Change News

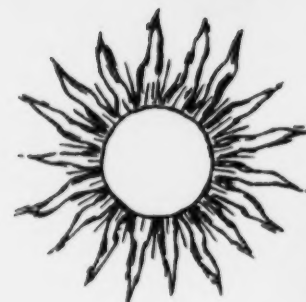


Produce a newspaper that is entirely devoted to the issues of global change. Assign a group to work on feature stories, a group to work on news stories, a group to draw political cartoons, a group to produce letters to the editors and an editorial, and a group to interview a famous scientist. (You might find a scientist to interview about related issues through the Internet, which has several “ask a scientist” options for students.)



32. Arguing Global Change

Design a statement that presents a controversial issue related to global change, such as the one in activity 12.



► **Plan and stage a debate based on your statement.**

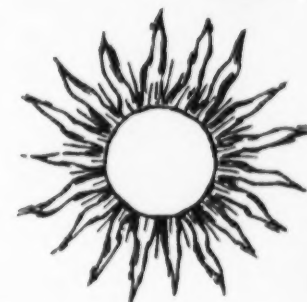
or

Write a role-play based on a global change issue. Give at least six opposing views on the issue. Provide ideas for the opposing views to develop in their presentation. Compose some questions for each representative of one view to ask a representative of another view. Allow each of the six players or groups of players ten minutes to present. Allow at least twenty minutes for an active discussion among the groups. Ask for a summary at the conclusion of your role-play.



33. Career Day

Research any of the following environmentally related careers, or find another career that has to do with global change:



agronomist
biochemist
botanist
chemical technician
chemist
conservationist
conservation officer
ecologist
entomologist
environmental analyst
environmental engineer
environmental health inspector

fishery aide
forester
forestry aid
forestry technician
game management agent
geologist
geophysicist
horticulturist
instrument technician
landscape architect
meteorologist

microbiologist
oceanographer
plant ecologist
plant morphologist
plant pathologist
plant taxonomist
range or soil conservation aide
range scientist
soil scientist
wildlife conservationist
zoologist

Look for specific details in how the career you have chosen helps the environment.

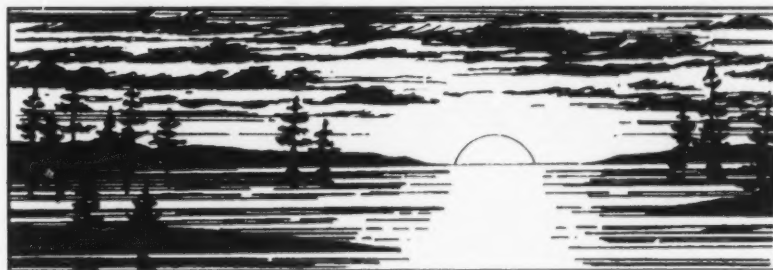
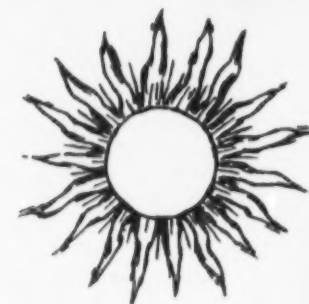
▶ **Prepare a pamphlet to give to someone who is interested in this career. Include details of what the career entails and the education necessary for the career.**

or

▶ **Invite someone to speak to the class who is currently employed in one of these careers. In advance, ask your classmates to prepare a list of questions to ask the speaker.**



34. Global Change Day



With your classmates and teacher, schedule and plan a day devoted to celebrating and sharing what you have learned about global change. Create a museum, prepare some food, dress in costumes that reflect global changes—use your imagination and pull out all the stops to reflect what you know while having a great time. Invite other classes to participate.



Answer Key

Puzzle Word Search

Unit 1 (page 34)

Unit 2 (page 61)

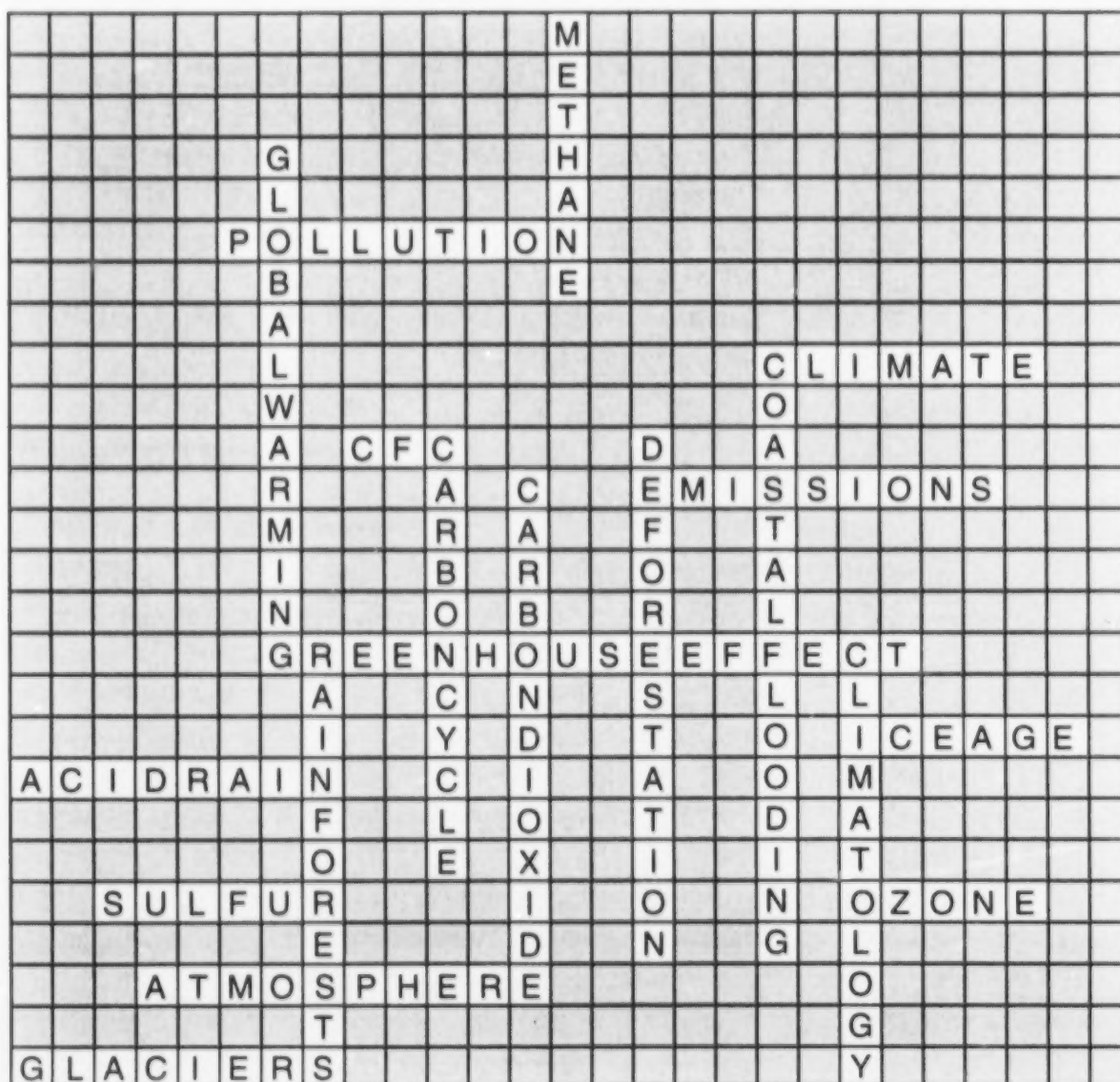
Global Change Word Search

B	T	H	L	A	X	H	H	E	Q	P	V	K	T	H	Y	W	D	Z	T
Y	I	C	G	P	C	P	B	I	Y	N	E	W	W	V	J	R	B	E	
J	P	Z	E	O	Q	O	E	A	M	G	L	I	C	T	O	I	U	F	C
I	S	E	J	F	R	G	A	G	T	O	O	B	A	P	V	M	F	T	U
C	C	T	D	W	F	Y	E	S	N	M	Z	L	B	R	X	H	L	H	D
N	A	E	S	I	G	E	N	M	T	A	O	O	O	D	D	Y	U	V	Y
O	M	R	A	E	X	N	E	E	I	A	H	S	N	T	Z	I	S	L	L
I	U	E	B	G	R	O	I	S	T	S	L	C	P	E	A	M	C	E	B
T	U	C	T	O	E	O	I	M	U	A	S	F	L	H	A	M	C	A	S
U	T	F	U	H	N	S	F	D	R	O	M	I	L	A	E	C	I	X	U
L	X	C	F	P	A	C	Z	N	N	A	H	I	O	O	B	R	V	L	I
L	E	Z	B	B	T	N	Y	D	I	O	W	N	L	N	O	O	E	G	C
O	Y	X	Q	G	S	H	E	C	D	A	B	L	E	C	S	D	L	P	E
P	Y	P	F	S	L	B	K	U	L	M	R	R	A	E	C	Z	I	G	F
W	G	V	S	J	X	N	X	H	E	E	H	K	A	B	R	T	D	N	G
D	E	F	O	R	E	S	T	A	T	I	O	N	E	C	O	G	W	P	G
T	G	L	A	C	I	E	R	S	I	O	N	I	U	Y	I	L	J	Q	Y
Z	L	I	E	Q	W	M	X	F	D	R	K	R	E	Q	P	B	G	H	P
V	D	V	Y	A	B	T	D	V	P	P	V	L	B	S	G	F	C	T	U
W	K	G	C	T	R	T	X	N	Q	W	W	T	V	U	T	I	N	U	X

Answer Key

Crossword Puzzle

Unit 2 (page 62)



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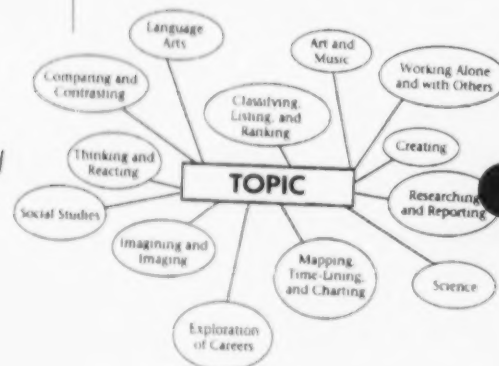
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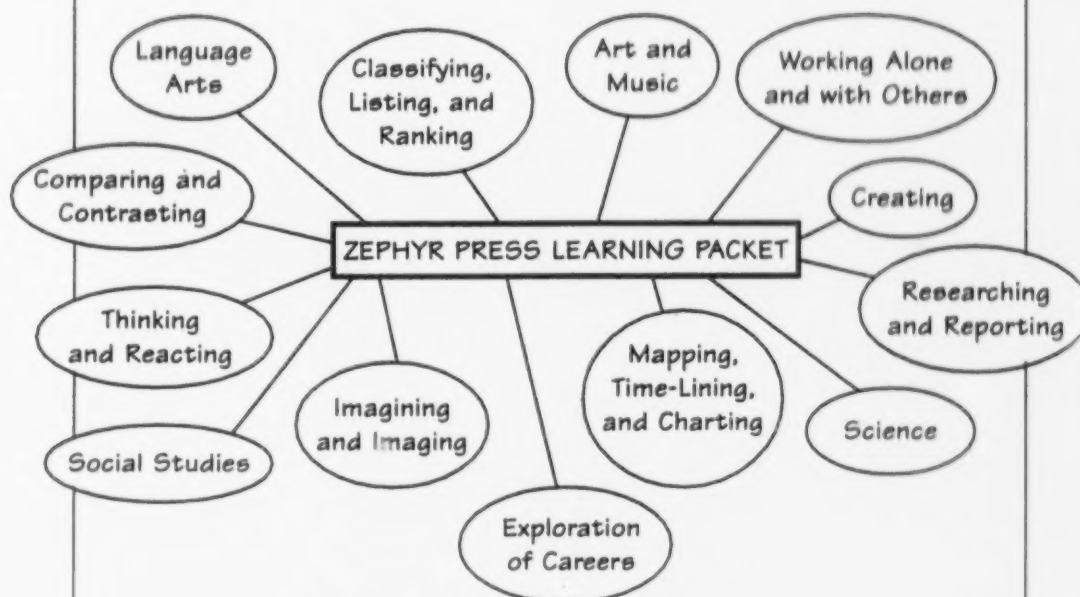
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